



**Table A. Selection criteria for ED visits.** These tables give more detail on both inclusion and exclusion criteria for ED visits in our sample, along with the rationale.

Linked claims to define ED visits		
We define an ED visit as an encounter with a provider for emergency evaluation and management		
File	Claim	Interpretation
Carrier (Provider)	HCPCS codes for emergency evaluation and management (levels 1-5, critical care)	Physician evaluation in the ED
Provider encounters are then linked to claims data from either:		
1) MedPAR (Inpatient)	Any MedPAR claim with ER amount > \$0*	Inpatient admissions originating in the ED
2) Outpatient	ER revenue centers*	Outpatient visits billing as EDs
What about observation care?		
Beneficiaries receiving observation care were classified according to their final disposition after observation care (i.e., admitted or discharged from observation). When applicable, mortality was calculated from date of the ED visit, not date of final disposition.		
File	Claim	Interpretation
MedPAR (Inpatient)	Observation to inpatient switch=="Y"	6.3% of inpatient admissions originating in the ED also had claim for observation care†
Outpatient	Observation care revenue center (0762)	4.8% of outpatient ED claims had claims for observation care on day of or day after ED visit. Leading discharge diagnoses were: chest pain (30%), syncope/dizziness (7.9%), atrial fibrillation (1.8%), and dehydration (1.7%)
Exclusions		
Item	Rationale	Notes
HMO during year before ED visit	Full claims data not observed	HMO flag at any time in year before visit
Over 90 years old	Potentially poor prognosis	
SNF	Potentially poor prognosis	SNF claims in 30 days before ED visits, or discharged to SNF from ED
Hospice/palliative	Potentially poor prognosis	
Dead in ED	Potentially poor prognosis	
Multiple ED visits on same day	Impossible to tell which visit was first or last, making assignment of a 'last visit' before death difficult	In practice, we would expect discharges followed by another unplanned ED visit on the same day to represent fairly high-risk encounters; excluding these would likely bias rates

of early death downward.

To the extent that transfers are miscoded as discharges, these high-risk encounters would also be excluded under this criterion.

Last 8 days of 2013	Full 7-day follow up period not observed
Facility type exclusions	Non ED facilities (e.g., fac_type==7, "Clinic or hospital-based renal dialysis facility," billing under ED revenue centers

\*Based on ResDAC definitions: <https://www.resdac.org/resconnect/articles/144>. We do additionally exclude certain facility types, above, that do not meet criteria for ED visits.

‡This determination was only possible after 2011, when the observation switch variable was introduced in the MedPAR file.

**Table B. Acute and chronic life-limiting diagnoses.** This table shows ICD codes that, when present, were judged by a panel of emergency physicians to represent a known potentially life-limiting diagnosis. This includes 1) chronic conditions in the year before visits (*e.g.*, metastatic cancer) indicating diagnosed life-limiting disease; and 2) acute events diagnosed in the ED (*e.g.*, myocardial infarction). Inter-rater reliability was calculated after several rounds of a Delphi-like process, on a random sub-sample of ED diagnoses grouped based on CCS codes (with minor clinically-oriented modifications, *e.g.*, separating pulmonary embolus from the CCS category of right heart disease; this list of modified categories is available from the author on request). Disagreements were resolved by consensus. If any such diagnosis was present in beneficiary claims, we assumed that both patient and provider were aware of the possibility of early death, and nonetheless deliberately decided to discharge the patient.

In calculating mortality rates (overall rates of early death after discharge, as well as rates shown in Figures 1 and 2), we wished to understand the frequency of potentially unexpected deterioration after medical evaluation. As described in the Methods, we therefore sought to exclude patients in whom doctors had diagnosed life-limiting disease, but nonetheless made the decision to avoid aggressive inpatient care. Thus while acute life-limiting diagnoses are excluded from mortality rate calculations for discharged patients, we did not exclude patients with acute life-limiting conditions who were admitted as inpatients. In these patients, physicians had diagnosed life-limiting disease, and presumably decided that inpatient care was warranted. Thus mortality in the inpatient setting would be unlikely to represent an unanticipated adverse event resulting from unexpected deterioration after ED evaluation.

ED diagnosis category	ICD-9 CM codes	Number discharged	Percent of all discharges	Number Admitted	Percent of all admitted
<b>Total Excluded: 3,878,744 (27.576%)</b>					
<i>Acute</i>		<i>2,382,575</i>	<i>16.939%</i>	<i>Acute life-limiting diagnosis exclusions applied only to discharged patients</i>	
AMI	410.x-411.x, 414.x	926,994	6.590%		
	800-809.x, 850-854.x, 860-869.x, 870-879.x, 900-904.x, 925-929.x, 952.x	493,260	3.507%		
Major trauma					
Sepsis, SIRS, Bacteremia, Viremia	38.x, 790.7, 790.8, 995.9x	232,731	1.655%		
Intracranial hemorrhage and stroke	430.x-438.x	185,944	1.322%		
Pulmonary edema, collapse, and respiratory failure	514.x, 518.x	81,757	0.581%		
GI hemorrhage	578.x	61,275	0.436%		
	574.x EXCEPT				
Cholecystitis	574.5x	55,241	0.393%		
Hyperkalemia	276.7	46,366	0.330%		
Bowel obstruction	560.x	43,878	0.312%		
Pancreatitis	577.x	44,160	0.314%		
DVT	453.x	38,995	0.277%		
Aortic dissection, aneurysm, and embolism	441.x-442.x, 444.x	34,703	0.247%		
Ill-defined causes of death	798.x, 799.0x- 799.1x, 799.3- 4x	34,673	0.247%		

Acute gastrointestinal ulcers & perforation	[531-534].1x-3x, 567.x, 569.83 427.1x,	28,803	0.205%		
VF, VT, arrest	427.4x-427.5x	16,078	0.114%		
Encephalopathies and other brain conditions	348.1, 348.3x-348.8x	10,703	0.076%		
Bone marrow disorders (incl. pancytopenia)	284.x	8,324	0.059%		
Pulmonary embolus & heart disease	415.x	7,638	0.054%		
Delirium	293.0-293.1	7,164	0.051%		
Osteomyelitis	730.x	6,620	0.047%		
C. difficile	008.45	4,899	0.035%		
Myasthenia gravis	358.0x	4,930	0.035%		
Empyema and pneumothorax	510.x, 512.x	2,578	0.018%		
Mesenteric ischemia	557.x	2,039	0.014%		
Gangrene	785.4x	1,694	0.012%		
Endocarditis	420.x	662	0.005%		
Shock	785.5x	466	0.003%		
<b>Chronic</b>		<b>1,496,169</b>	<b>10.637%</b>	<b>2,460,743</b>	<b>26.30%</b>
Malignant neoplasms	140.x-209.x	658,633	4.682%	1,210,715	12.94%
Degenerative CNS (incl. Alzheimer's, Parkinson's)	331.x-332.x, 335.x	593,591	4.220%	678,199	7.25%
Anorexia, failure to thrive, debility, and cachexia	783.0, 783.2, 783.7, 799.3, 799.4	139,057	0.989%	199,697	2.13%
Dementias	290.x	88,511	0.629%	313,989	3.36%
Hepatic encephalopathy	572.2	10,210	0.073%	47,537	0.51%
Tracheostomy complications	519.0x	5,170	0.037%	9,417	0.10%
Neoplasm related pain	338.3	997	0.007%	1,189	0.01%

**Table C. Supplementary logistic regression results for control variables.** Odds ratio (OR) with 95% confidence interval (95% CI) and *p*-value (*p*) for main variables of interest are shown in Table 2. This table shows odds ratios associated with control variables, all of which are included in the regression presented in the main text, but are presented here to simplify presentation: hospital admission rate bin indicators, comorbidity indicators, season and year indicators, and indicator for a weekend visit.

Variable	Model 1: All ED patients <i>n</i> =15,961,327		Model 2: Discharged only <i>n</i> =10,093,678	
	OR (95% CI)	<i>p</i>	OR (95% CI)	<i>p</i>
<b>Hospital Admission Rates</b>				
0-15%		<i>reference</i>		
15-20%	0.65 (0.58 to 0.73)	<.001	0.77 (0.70 to 0.86)	<.001
20-25%	0.44 (0.39 to 0.48)	<.001	0.65 (0.59 to 0.71)	<.001
25-30%	0.36 (0.33 to 0.40)	<.001	0.59 (0.54 to 0.65)	<.001
30-35%	0.33 (0.3 to 0.36)	<.001	0.56 (0.51 to 0.61)	<.001
35-40%	0.30 (0.27 to 0.33)	<.001	0.53 (0.48 to 0.58)	<.001
40-45%	0.27 (0.24 to 0.3)	<.001	0.50 (0.45 to 0.55)	<.001
45-50%	0.22 (0.2 to 0.25)	<.001	0.46 (0.41 to 0.51)	<.001
50-55%	0.18 (0.16 to 0.21)	<.001	0.40 (0.35 to 0.45)	<.001
55-60%	0.16(0.13 to 0.2)	<.001	0.39 (0.32 to 0.48)	<.001
60-65%	0.04 (0.02 to 0.07)	<.001	0.15 (0.26 to 0.52)	<.001
65+	0.13 (0.09 to 0.18)	<.001	0.37 (0.32 to 0.48)	<.001
<b>Comorbidities</b>				
Alcohol abuse	1.31 (1.2 to 1.43)	<.001	1.23 (1.13 to 1.35)	<.001
Deficiency anemias	1.24 (1.19 to 1.3)	<.001	1.28 (1.23 to 1.34)	<.001
Cardiac arrhythmias	1.15 (1.09 to 1.2)	<.001	1.18(1.12 to 1.23)	<.001
Congestive heart failure	1.59 (1.52 to 1.68)	<.001	1.77 (1.68 to 1.86)	<.001
Coagulopathy	1.14 (1.07 to 1.22)	<.001	1.18 (1.11 to 1.26)	<.001
Complicated diabetes	1.10 (1.04 to 1.15)	<.001	1.13 (1.07 to 1.19)	<.001
Fluid & electrolyte disorders	1.35 (1.29 to 1.42)	<.001	1.43 (1.37 to 1.50)	<.001
Hemiplegia	1.15 (1.05 to 1.27)	0.004	1.31 (1.19 to 1.45)	<.001
HIV/AIDS	1.36 (1.12 to 1.66)	0.002	1.35 (1.11 to 1.64)	0.003
Hypertension	0.77 (0.73 to 0.82)	<.001	0.74 (0.7 to 0.78)	<.001
Liver disease	1.22 (1.13 to 1.31)	<.001	1.14 (1.05 to 1.23)	0.001
Psychosis	1.19 (1.13 to 1.25)	<.001	1.22 (1.16 to 1.28)	<.001
Pulmonary circ. disorders	1.44 (1.35 to 1.53)	<.001	1.57 (1.47 to 1.67)	<.001
Chronic pulmonary disease	1.26 (1.21 to 1.31)	<.001	1.30 (1.24 to 1.35)	<.001
Peripheral vasc. disease	1.07 (1.02 to 1.12)	0.004	1.14 (1.09 to 1.2)	<.001
Renal failure	1.47 (1.4 to 1.54)	<.001	1.63 (1.55 to 1.71)	<.001
Any tumor	0.92 (0.86 to 0.98)	0.010	0.87 (0.81 to 0.93)	<.001
Weight loss	1.53 (1.42 to 1.64)	<.001	1.79 (1.66 to 1.93)	<.001
<b>Year</b>				
2007	1.17 (1.09 to 1.25)	0.792	1.43 (1.33 to 1.53)	<.001
2008	1.15 (1.07 to 1.23)	<.001	1.35 (1.26 to 1.44)	<.001
2009	1.19 (1.11 to 1.27)	<.001	1.31 (1.22 to 1.4)	<.001
2010	1.17 (1.09 to 1.25)	<.001	1.25 (1.16 to 1.33)	<.001
2011	0.95 (0.88 to 1.02)	<.001	1.00 (0.94 to 1.08)	0.915
2012		<i>reference</i>		
<b>Season</b>				
Fall	1.06 (1.00 to 1.12)	0.038	1.07 (1.01 to 1.12)	0.019
Spring	1.09 (1.04 to 1.15)	0.001	1.12 (1.06 to 1.19)	<.001
Winter	1.23 (1.16 to 1.29)	<.001	1.28 (1.21 to 1.35)	<.001
Summer		<i>reference</i>		
<b>Weekend visit</b>	0.95 (0.92 to 0.99)	0.024	0.95 (0.91 to 0.99)	0.015

**Table D. Cause of death and antecedent ED discharge diagnoses.** ICD-10 codes from death certificates for early deaths after discharge. Codes were grouped into categories using clinically relevant categories developed for the UK Summary Hospital-level Mortality Indicator.<sup>1</sup>

Grouped SHMI Category	ICD 10 Code	ICD 10 Percent	Group Percent
Acute myocardial infarction	I219 Acute myocardial infarction, unspecified	10.3	10.3
Other and ill-defined heart disease	I251 Atherosclerotic heart disease	8.4	13.6
Chronic obstructive pulmonary disease and bronchiectasis	J449 Chronic obstructive pulmonary disease, unspecified	7.3	9.9
Diabetes mellitus with complications	E149 Unspecified diabetes mellitus without complications	3.6	6.2
Other and ill-defined heart disease	I250 Atherosclerotic cardiovascular disease, so described	3.0	13.6
Congestive heart failure; nonhypertensive	I500 Congestive heart failure	2.7	3.1
Pneumonia	J189 Pneumonia, unspecified	2.4	2.6
Accidental poisoning by and exposure to other and unspecified drugs	X44 Accidental poisoning by and exposure to other and unspecified drugs, medicaments, and biological substances	2.3	2.3
Septicaemia	A419 Septicemia, unspecified	1.8	2.0
Nephritis; nephrosis; renal sclerosis, Chronic renal failure	N180 End-stage renal disease	1.7	2.2
Acute cerebrovascular disease	I64 Stroke, not specified as hemorrhage or infarction	1.4	2.7
Other	I469 Cardiac arrest, unspecified	1.3	36.0
Hypertension with complications	I119 Hypertensive heart disease without (congestive) heart failure	1.2	3.0
Diabetes mellitus with complications	E119 Non-insulin-dependent diabetes mellitus without complications	1.2	6.2
Peri-; endo-; and myocarditis; cardiomyopathy	I429 Cardiomyopathy, unspecified	1.1	1.9
Acute and unspecified renal failure	N19 Unspecified renal failure	1.1	1.7
Other	X42 Accidental poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified	1.1	36.0
Chronic obstructive pulmonary disease and bronchiectasis	J439 Emphysema, unspecified	1.1	9.9
Chronic obstructive pulmonary disease and bronchiectasis	J440 Chronic obstructive pulmonary disease with acute lower respiratory infection	0.9	9.9
Other	I10 Essential (primary) hypertension	0.9	36.0
Other	X74 Intentional self-harm (suicide) by other and unspecified firearm	0.8	36.0

<sup>1</sup> <http://www.hscic.gov.uk/SHMI>

	discharge		
Urinary tract infections	N390 Urinary tract infection, site not specified	0.8	0.8
Hypertension with complications	I120 Hypertensive renal disease with renal failure	0.8	3.0
Other and ill-defined heart disease	I259 Chronic ischemic heart disease, unspecified	0.7	13.6
Other	I269 Pulmonary embolism without mention of acute cor pulmonale	0.7	36.0
Other	R99 Other ill-defined and unspecified causes of mortality	0.7	36.0
Other	I350 Aortic (valve) stenosis	0.7	36.0
Other	J690 Pneumonitis due to food and vomit	0.7	36.0
Other	C349 Malignant neoplasm of bronchus or lung, unspecified	0.6	36.0
Hypertension with complications	I110 Hypertensive heart disease with (congestive) heart failure	0.6	3.0
Other	K746 Other and unspecified cirrhosis of liver	0.6	36.0
Other	J841 Other interstitial pulmonary diseases with fibrosis	0.6	36.0
Nephritis; nephrosis; renal sclerosis, Chronic renal failure	N189 Chronic renal failure, unspecified	0.5	2.2
Acute cerebrovascular disease	I619 Intracerebral hemorrhage, unspecified	0.5	2.7
Acute and unspecified renal failure	N179 Acute renal failure, unspecified	0.5	1.7
Other	I48 Atrial fibrillation and flutter	0.5	36.0
Other	K922 Gastrointestinal hemorrhage, unspecified	0.5	36.0
Other	W19 Unspecified fall	0.5	36.0
Peri-; endo-; and myocarditis; cardiomyopathy	I420 Dilated cardiomyopathy	0.5	1.9
Other	K559 Vascular disorder of intestine, unspecified	0.5	36.0
Other	E785 Hyperlipidemia, unspecified	0.5	36.0
Other	K703 Alcoholic cirrhosis of liver	0.4	36.0
Coronary atherosclerosis and other heart disease		0.4	0.4
Other and ill-defined heart disease	I255 Ischemic cardiomyopathy	0.4	13.6
Other and ill-defined heart disease	I519 Heart disease, unspecified	0.4	13.6
Mental retardation, Senility and organic mental disorders	F03 Unspecified dementia	0.4	1.1
Congestive heart failure; nonhypertensive	I509 Heart failure, unspecified	0.4	3.1
Other	E668 Other obesity	0.4	36.0
Other	I272 Other secondary pulmonary hypertension	0.4	36.0
Mental retardation, Senility and organic mental	G309 Alzheimer's disease, unspecified	0.4	1.1

disorders			
Other	I461 Sudden cardiac death, so described	0.4	36.0
Other	W18 Other fall on same level	0.4	36.0
Other	G931 Anoxic brain damage, not elsewhere classified	0.3	36.0
Other	X64 Intentional self-poisoning (suicide) by and exposure to other and unspecified drugs, medicaments, and biological substances	0.3	36.0
Other	X72 Intentional self-harm (suicide) by handgun discharge	0.3	36.0
Diabetes mellitus with complications	E109 Insulin-dependent diabetes mellitus without complications	0.3	6.2
Other	I38 Endocarditis, valve unspecified	0.3	36.0
Other	I499 Cardiac arrhythmia, unspecified	0.3	36.0
Other	J459 Asthma, unspecified	0.3	36.0
Other and ill-defined heart disease	I516 Cardiovascular disease, unspecified	0.3	13.6
Other	F102 Mental and behavioral disorders due to use of alcohol, dependence syndrome	0.3	36.0
Other	I710 Dissection of aorta [any part]	0.3	36.0
Other	J984 Other disorders of lung	0.3	36.0
Other	K566 Other and unspecified intestinal obstruction	0.3	36.0
Other	V892 Person injured in unspecified motor-vehicle accident, traffic	0.3	36.0
Acute cerebrovascular disease	I629 Intracranial hemorrhage (nontraumatic), unspecified	0.3	2.7
Other	G20 Parkinson's disease	0.3	36.0
Other	G809 Infantile cerebral palsy, unspecified	0.3	36.0
Other	K550 Acute vascular disorders of intestine	0.3	36.0
Other	N/A N/A	0.3	36.0
Other	X70 Intentional self-harm (suicide) by hanging, strangulation, and suffocation	0.3	36.0

**Table E. Fraction of all mortality accounted for by short-term deaths post-ED discharge.** To contextualize our estimated number of deaths in the 7 days after ED discharge, we compare it to the total number of deaths in the Medicare fee-for-service population, excluding those deaths preceded by hospice enrolment to focus on those beneficiaries not clearly known to be at the end of life.

Year	Medicare FFS population (millions)‡	Medicare FFS mortality rate‡	Medicare FFS deaths (millions)			Medicare FFS non-hospice deaths
2005				0.32		
2006				0.35	*	
2007	29.0	0.050	1.45	0.37	*	540,125
2008	28.7	0.050	1.43	0.40	*	570,054
2009	28.7	0.048	1.38	0.42		581,347
2010	29.0	0.048	1.39	0.45	°	621,876
2011	29.2	0.048	1.40	0.47	°	660,854
2012	29.5	0.047	1.39	0.50	°	688,051

Mean annual estimate, 2007-12	
Medicare FFS deaths	610,384
7-day mortality after ED discharge	10,093
Percent of all deaths	1.654%

‡ From Krumholz et al., Mortality, Hospitalizations, and Expenditures for the Medicare Population Aged 65 Years or Older, 1999-2013, *JAMA* 2015

° From Teno et al., Change in End-of-Life Care for Medicare Beneficiaries, *JAMA* 2013

\* Linear interpolation

° Linear extrapolation